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(54) [Title of the Invention] ANTIMICROBIAL LUBRICANT

(57) [Abstract]

[Object] To give, in addition to lubricity and antimicrobial properties, anti-cracking properties to an antibacterial lubricant to be spread over a conveyor belt of a line conveyor for bottle transportation.

[Means to Attain the Object] An antimicrobial lubricant contains a cationic surfactant (Component A) having antimicrobial properties and a fluorine-containing surfactant (Component B), the ratio of B to A + B being 10-50 wt.%.

[Patent Claims]

[Claim 1] An antimicrobial lubricant containing a cationic surfactant (Component A) having antimicrobial properties and a fluorine-containing surfactant (Component B), wherein the compounding ratio of Component B is 10-50 wt.% of the total amount of Component A and Component B.

[Claim 2] An antimicrobial lubricant containing a cationic surfactant (Component A) having antimicrobial properties and an organometallic surfactant (Component C), wherein the compounding ratio of Component C is 10-50 wt.% of the total amount of Component A and Component C.

[Claim 3] An antimicrobial lubricant containing a cationic surfactant (Component A) having antimicrobial properties, a fluorine-containing surfactant (Component B), and an organometallic surfactant (Component C), wherein the combined compounding ratio of Component B and Component C is 10-50 wt.% of the total amount of Component A, Component B, and Component C.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Utilization] The present invention relates to an antimicrobial lubricant designed to decrease kinetic friction resistance between bottles and conveyor belts and to prevent bottles from toppling over on line conveyors for transportation of bottles in beverage filling plants, the lubricant being also suitable for maintaining the line in a sanitary state.

[0002]

[Prior Art Technology] Conventional antimicrobial lubricants used in line conveyors combining anionic surfactants with antimicrobial amphoteric surfactants are well known (Japanese Examined Patent Application No. 4-6757).

[0003]

[Problems Addressed by the Present Invention] In recent years, polyethylene terephthalate bottles ("PET bottles") have been widely used for beverages. However, when the conventional antimicrobial lubricants were employed, a large number of cracks appeared on the bottom of PET bottles and cases of the propagation of the cracks resulting in rupture of PET bottles filled with carbonated beverages have been reported.

[0004] Accordingly, it is desired that antimicrobial lubricants be given anti-cracking properties. However, since it is difficult to obtain an antimicrobial lubricant with anti-cracking properties without losing lubricity and antimicrobial properties, the demand for antimicrobial lubricants satisfying the three conditions at the same time has not yet been met.

[0005] With the foregoing in view, it is an object of the present invention to provide an antimicrobial lubricant that combines lubricity and antimicrobial properties with excellent anti-cracking properties.

[0006]

[Means to Resolve the Problems] To attain this object, the invention described in Claim 1 provides an antimicrobial lubricant containing a cationic surfactant (Component A) having antimicrobial properties and a fluorine-containing surfactant (Component B), wherein the compounding ratio of Component B is 10-50 wt.% of the total amount of Component A and Component B

[0007] Further, the invention described in Claim 2 provides an antimicrobial lubricant containing a cationic surfactant (Component A) having antimicrobial properties and an organometallic surfactant (Component C), wherein the compounding ratio of Component C is 10-50 wt.% of the total amount of Component A and Component C.

[0008] The invention described in Claim 3 provides an antimicrobial lubricant containing the Component A, Component B, and Component C, wherein the combined compounding ratio of Component B and Component C is 10-50 wt.% of the total amount of Component A, Component B, and Component C.

[0009] The present invention is based on the finding that in a composition containing Component A and Component B and/or Component C, all three requirements relating to lubricity, antimicrobial properties, and anti-cracking properties are effectively satisfied when the content of Component B and/or Component C is at the preset compounding ratio with the total amount of Component A and Component B and/or Component C.

[0010] Examples of Component A used in accordance with the present invention include pyridium compounds obtained by reacting a tertiary amine compound having 1-2 alkyl groups containing 8-18 carbon atoms, methyl chloride, methyl bromide, benzyl chloride, dimethyl sulfate and the like with pyridine or pyridine derivatives, and alkyls having 7-17 carbon atoms; those compounds can be used individually or in a mixture of two or more thereof.

[0011] Examples of preferred substances for Component A are alkyltrimethyl ammonium halides, dialkyldimethyl ammonium halides, alkyldimethylbenzyl ammonium halides, dialkylmethylbenzyl ammonium halides, alkylpyridinum halides and the like, more specifically, cocoalkyltrimethyl ammonium chloride, lauryltrimethyl ammonium bromide, cetyltrimethyl ammonium bromide, dioctyldimethyl ammonium chloride, didecyldimethyl ammonium chloride, cocoalkyldimethylbenzyl ammonium chloride, lauryltrihydroxyethyl ammonium hydroxide, lauryl pyridium bromide, and the like.

[0012] Component B used in accordance with the present invention is obtained by substituting all the hydrogen bonded to carbon in hydrophobic groups of ordinary surfactants with fluorine and can be classified into anionic (-COOM, $-OSO_3M$, $-SO_3M$ and the like, where M is an alkali

metal) surfactants, cationic surfactants, amphoteric surfactants, anionic surfactants, and polymer surfactants. Surfactants of any of these types may be used. Moreover, they can be used individually or in combinations of two or more thereof.

[0013] Preferred Component Bs are classified as anionic surfactants. Specific examples include sodium trifluoroacetate, lithium trifluorosulfonate and the like.

[0014] Component C in accordance with the present invention is a compound having a metal other than an alkali metal in a main chain of a surfactant molecule. Examples of metals other than alkali metals mainly include Si, Ti, Sn, Zr, Ge and the like. Component Cs can be classified into anionic (carboxylic acid, sulfuric acid ester) surfactants, cationic (amine salt, quaternary ammonium salt) surfactants, anionic surfactants, and polymer surfactants. Surfactants of any of those types may be used. Moreover, they can be used individually or in combinations of two or more thereof.

[0015] Preferred Component Cs are classified as anionic surfactants. Specific examples of preferred compounds include 3-(dimethylphenylsilyl)propanoid, 4,4,6,6-tetramethyl-5-oxa-4,6-disilanonane dipropanoid and the like.

[0016] In case of an antimicrobial surfactant containing Component A and Component B, the content ratio of Component B to the total amount of Component A and Component B is required to be 10-50 wt.%, preferably, 20-40 wt.%. Furthermore, in case of an antimicrobial surfactant containing Component A and Component C, the content ratio of Component C to the total amount of Component A and Component C is required to be 10-50 wt.%, preferably, 20-40 wt.%. In case of an antimicrobial surfactant containing Component A, Component B, and Component C, the content ratio of the combined total of Component B and Component C to the total amount of Component A, Component B, and Component C is required to be 10-50 wt.%, preferably, 20-40 wt.%. Moreover, the weight ratio of Component B and Component C is preferably 1 : 9 ~ 4 : 6.

[0017] If the compounding amount of Component B and/or Component C in the total amount of Component A and Component B and/or Component C is too high, then the antimicrobial properties are degraded, and if the amount of Component B and/or Component C is too small, the lubricity and anti-cracking properties are degraded.

[0018] The present antimicrobial lubricant is ordinarily used upon 100-300-fold dilution with water; the degree of dilution may be adjusted according to the hardness of water used.

[0019] Furthermore, the present antimicrobial lubricant can also contain appropriate amounts of nonionic surfactants (for example, polyethylene glycol fatty acid esters and the like) to prevent contamination of conveyor belts, chelating agents (for example, EDTA-4Na and the like) to prevent the formation of deposits on conveyor belts, antifoaming agents (for example, polyoxyethylene and the like) to prevent foaming which impedes the inspection of bottles, and stabilizers (for example, isopropyl alcohol and the like) to stabilize the formulation.

[0020]

[Operations] In accordance with the present invention, Component A provides the lubricant with antimicrobial properties and Component B and Component C provide it with lubricity and anti-cracking properties. Furthermore, when in the combination of Component A and Component B and/or Component C, the Component B and/or Component C are at the preset ratio to the total amount of Component A and Component B and/or Component C, balanced lubricity, antimicrobial properties and anti-cracking properties are demonstrated, while no component affects the workings of the other components.

[0021]

[Embodiments] First, methods for evaluating the evaluation items used in embodiments and comparative examples will be described.

[0022] (1) Evaluation of lubricity

(a) Test conveyor conditions

Conveyor speed: 30 m/min
Test bottles : two self-standing PET bottles with a capacity of 1.5 L filled with 4 VOL carbonated water were used.

[0023] (b) Evaluation method

Test bottles were placed on a plastic conveyor plate and friction coefficients were determined after 10 min during which the samples shown in Table 4 were supplied at a rate of 100 mL/min. Calculation of friction coefficients was conducted by the following formula by using the spring balance tension resistance required to stop the test bottle moving forward. The lubricity was evaluated based on criteria shown in Table 1.

[0024] Friction coefficient = (spring balance tension resistance)/(test bottle weight)

[0025]

[Table 1]

Evaluation mark	Friction coefficient	Lubricity
O	no more than 0.02	good lubrication
Δ	0.02 to 0.03	somewhat insufficient lubrication
X	no less than 0.03	practically no lubrication

(2) Evaluation of antimicrobial capacity

According to the inspection guidance of the Food Sanitation Act, samples shown in Table 4 were diluted at a ratio of 200 with sterilized water, and various bacteria (colibacili, staphylococci) were mixed with the diluted samples for 2 min and 30 s at a temperature of 25°C. The liquid

mixtures were inoculated with 1 platinum loop in liquid cultures and the multiplication of bacteria was examined under incubation conditions of 48 h at a temperature of 37°C. The evaluation was conducted according to criteria shown in Table 2.

[0026]

[Table 2]

Evaluation mark	Evaluation criteria
+	Multiplication was observed (multiplication ratio exceeds 0%)
-	Multiplication was not observed (multiplication ratio is 0%)

(3) Evaluation of anti-cracking properties

A self-standing PET bottle with a capacity of 1.5 L was filled with 4VOL carbonated water and the bottom portion of the bottle was immersed for 10 min in aqueous solutions containing samples shown in Table 4 that were diluted at a ratio of 200. The bottle removed from the solution was stored for 1 day in an environment with a temperature of 40°C and a humidity of 90%, and cracks appearing in the bottle bottom were examined. The evaluation was conducted according to criteria shown in Table 3.

[0027]

[Table 3]

Evaluation mark	Evaluation criteria
O	Only very few cracks were observed
Δ	Cracks were observed but they did not propagate (crack length was no more than 5 mm)
X	Cracks were observed and they propagated (length of cracks exceeded 5 mm)

Embodiment 1 and Comparative Example 1

Cetyltrimethyl ammonium bromide (A_1) was used as Component A and sodium trifluoroacetate (B) was used as Component B. Mixtures with seven different amounts of Component B were prepared, as shown in Table 4, and diluted with water at a ratio of 200. The lubricity, antimicrobial properties, and anti-cracking properties were evaluated.

[0028] The results are shown in Table 4.

[0029] Embodiment 2 and Comparative Example 2

Cocoalkyldimethylbenzyl ammonium chloride (A_2) was used as Component A and 3-(dimethylphenylsilyl)propanoid (C) was used as Component C. Mixtures with seven different

amount of Component C were prepared, as shown in Table 4, and diluted with water at a ratio of 200. The lubricity, antimicrobial properties, and anti-cracking properties were evaluated.

[0030] The results are shown in Table 4.

[0031] Comparative Example 3

A commercial lubricant was used as a sample and evaluated in the same manner as in Embodiment 1.

[0032] The results are shown in Table 4.

[0033]

[Table 4]

Sample	Amount of B and/or C (wt.%)	Lubricity	Antimicrobial properties		Anti-cracking properties
			Staphylococci	Colibacili	
A_1 + B	1	X	-	-	X
	10	Δ	-	-	Δ
	20	O	-	-	O
	40	O	-	-	O
	50	Δ	-	-	O
	70	Δ	+	+	Δ
	100	Δ	+	+	Δ
A_2 + C	1	X	-	-	X
	10	O	-	-	Δ
	20	O	-	-	O
	40	O	-	-	O
	50	O	-	-	O
	70	O	+	+	O
	100	O	+	+	Δ
Commercial product	-	O	-	-	X

Embodiment 3 and Comparative Example 4

A_1 and B employed in Embodiment 1 and Comparative Example 1 were used as Component A and Component B, and C employed in Embodiment 2 and Comparative Example 2 was used as Component C. The weight ratio of Component B and Component C was 3:7. Mixtures with seven different amounts of Component B and Component C were prepared, as shown in Table 5, and diluted with water at a ratio of 200. The lubricity, antimicrobial properties, and anti-cracking properties were evaluated.

[0034] The results are shown in Table 5.

[0035]

[Table 5]

Sample	Amount of B and/or C (wt.%)	Lubricity	Antimicrobial properties		Anti-cracking properties
			Staphylococci	Colibacili	
$A_1 + B + C$	1	X	-	-	X
	10	Δ	-	-	Δ
	20	O	-	-	O
	40	O	-	-	O
	50	O	-	-	O
	70	O	+	+	O
	100	Δ	+	+	Δ

[0036]

[Effect of the Invention] The present invention, as described above, provides a lubricant with excellent lubricity, antimicrobial properties, and anti-cracking properties. Therefore, beverage-filling operations can be conducted under good sanitary conditions, while the bottles are being smoothly transported, without decreasing the bottle strength, and the reliability of bottle filling and packaging can be increased.

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